

THE FOSSIL ESTHERIAE OF AUSTRALIA. PART I.

By JOHN MITCHELL, late Principal of the Technical College
and School of Mines, Newcastle, N.S.W.

(Plates ii-iv.)

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Introduction.

The earliest record (Cox, These PROCEEDINGS, 1880, p. 276) of the occurrence of fossil *Estheria* in Australia was made by Dr. J. C. Cox from the Moore Park Diamond Drill bore; and to this first specimen Dr. Cox gave the name *Estheria coghlani*, after Mr. John Coghlan of the Diamond Drill Company, who was directing the work of sinking the bore referred to, but he neither described nor figured the species. The species was subsequently described by the late R. Etheridge, Junr. (*Mem. Geol. Survey, N. S. Wales*, 1888, Pal. No. I, pp. 6-8, Pl. i, figs. 1-10). The next reference to the occurrence of fossil Estheriae in Australian rocks was also made by R. Etheridge Junr., who in 1892 referred some specimens of this genus, obtained from Denmark Hill, near Ipswich, Queensland, to *E. mangaliensis* Jones (Jack and Etheridge, *Geol. and Pal. Queensland and N.G.*, 1892, p. 387). In 1909 I recorded the discovery of Estheriae in the Newcastle coal measures (Notes and Exhibits, These PROCEEDINGS, 1909, p. 411-12).

In 1925 I referred to the presence of Estheriae in the Belmont chert (tuff) beds. (Descriptions of new species of *Leaia*, These PROCEEDINGS, 1925, p. 438.)

During the year 1890 I collected several specimens of Estheriae from the Wianamatta series near Glenlee, but did not record the find at the time.

It will be seen by the above record that the geologic range of *Estheria* has been considerably extended since 1892, which will be obvious from the following list of the series of rocks from which they have been collected to date, viz.:

1. Wianamatta Series, about 700 feet thick (Clarke) (but probably exceed 1,000 feet in the vicinity of Cobbitty).
2. *Estheria* Shales, about 610 feet thick (David).
3. Newcastle Coal Measures, 1,100 or more feet thick (David).

To complete the actual stratigraphical range of these fossils, the intervening series between the Wianamatta and the Newcastle Coal Measure must be included, as follows:

1. Wianamatta series, about 700 feet thick (Clarke).
2. Hawkesbury Sandstone, about 1,000 feet thick (Wilkinson).
3. Narrabeen Shales, about 650 feet thick (David).
4. *Estheria* Shales, about 610 feet thick (David).
5. Newcastle Coal Measures, about 1,100 feet thick (David).

The total thickness of these together exceeds 4,000 feet; but that does not by any means represent the full geologic range of these fossils in New South Wales as far as present knowledge discloses, for there are at least two gaps in the portion

of the geologic record shown above, and these represent a considerable length of time even from a geologic point of view. These gaps occur between the Wianamatta beds on the one hand, and the Hawkesbury Sandstones on the other, and again, between the *Estheria* Shales and the Newcastle Coal Measures.

That the gap between the close of the Hawkesbury Sandstone Series and the commencement of the deposition of the Wianamatta Series thereon represents a considerable length of time is shown by the extensive weathering the former had undergone before conditions arose to admit of the formation of the latter; and that the break between the Newcastle Measures and the subsequent deposition upon them of the Mesozoic measures represents a great length of time, is shown by the great changes in the fossil Flora ushered in with the Mesozoic deposits lying immediately upon the Newcastle measures. The length of this lapse of time is further emphasized when the denudation of the lower measures before the upper series began to be laid upon them is also considered.

The Mode of their Occurrence.

In the lower portion of the *Estheria* Shales and in the Wianamatta Series they occur in thin bands of impure clay ironstone. In the Newcastle Measures at Belmont and at Warner's Bay, they are found in cherts (tuffs). Judging by the fossils associated with them, it would appear that in each case they were dwellers in fresh, or slightly brackish waters. Those from Belmont and Warner's Bay occur as casts only; but those from Merewether Beach, Newcastle, from the *Estheria* Shales and the Wianamatta beds often have tests preserved. Those obtained from the *Estheria* Shales and the Wianamatta Beds are black and lustrous, but those from the Newcastle beds (Merewether Beach) are of a dun colour. It is not uncommon to find specimens with two valves conjoined, but never free from the matrix, so far as I am aware.

The variety of forms of *Estheria* obtained from the Newcastle Coal Measures is remarkable.

From Victoria, South Australia, West Australia and Tasmania, the occurrence of fossil *Estheria*, so far as I am aware, remains to be recorded.

Largely owing to imperfect preservation my attempts to obtain satisfactory microscopic enlargements of the ornamentations of the interspatial areas of the *Estheria* dealt with in the present paper have not been successful; therefore I decided not to make any special reference to these particular features of this interesting genus so well represented in the Upper Permian rocks of the Newcastle Coal measures of New South Wales.

ESTHERIA COGILANI Cox. Plate ii, figs. 3, 4, 5.

PROC. LINN. SOC. N.S.W. 1880, p. 276 (1881); Etheridge, Junr., *Mem. Geol. Surv. N.S.W.*, 1888, Pl. No. 1, Pl. i, figs. 1-10.

To Mr. Etheridge's description of this species nothing remains to be added. He was of the opinion that among the drawings and specimens examined by him there was a second species. On comparing his figures 1, 3, 6 with figures 8 and 9 that opinion seems to have good evidence to support it. After a careful study of a large number of the specimens from the *Estheria* beds, my view on the point in question agrees with that of Mr. Etheridge, but available evidence is not yet quite conclusive.

The range through geologic time of *E. coghlani* was considerable, for at least one specimen of it was obtained by me from the Wianamatta formation at Glenlee, thus affording evidence of its persistence throughout the Triassic formations as far as represented in New South Wales.

ESTHERIA IPSWICIENSIS, n. sp. Plate iii, figs. 1-4.

Estheria mangaliensis Etheridge (nec Jones), Jack and Eth., *Geol. and Pal. of Queensland and N.G.*, 1892, p. 387.

The late R. Etheridge Junr. described this species but did not figure it. He referred it to *E. mangaliensis* Jones. His description of it is as follows: "Valves broadly subovate, hardly convex; dorsal margin straight, about half the length of the valves, terminated at the anterior end by the umbones; anterior, posterior and ventral margins fully and broadly rounded, the anterior shorter than the posterior, rendering the valves narrower at the former of the two ends; umbones depressed; ridges twelve in number, but probably two or three more exist on each umbo, strong and well marked; interspaces wide, depressed, or perhaps very slightly concave, especially towards the ventral portion of the valves; reticulation not preserved. Length about three-sixteenths of an inch."

"Observations: This little fossil, the first *Estheria* found in the secondary rocks of Queensland, appertains to the group represented by such species as *E. mangaliensis*, *E. Forbesi*, etc., and in fact is so very close to the former in its general features, that I am constrained to consider it as identical, notwithstanding the absence of the reticulated surface in our fossil. It is particularly like Professor Jones' Pl. 2, fig. 16."

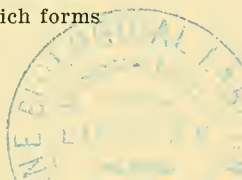
In the above description and observations there appear to be some inaccuracies which require correction; and to enable me to make these corrections I have through the courtesy of Mr. B. Dunstan, Chief Govt. Geologist, Dept. of Mines, Brisbane, before me the specimens used by Mr. Etheridge when making his description and determination of the *Estheria* under review.

In the first place the valves of the carapaces of this *Estheria* are said to be hardly convex, instead of being strongly so, when not flattened by external pressure. The interspaces are neither wide nor depressed, but narrow and convex, and flat near the ventral margin. Owing to the gradual way in which the dorsal margin merges into the posterior margin it is difficult to give the exact ratio which the dorsal margin of the Ipswich *Estheria* bears to the total length of its valves; but the following measurements taken with care will result in a fairly accurate estimate of the ratio being arrived at:

1. Length of dorsal margin and of valve 4: 7 (No. 55 in Coll. Mitchell).
2. Length of dorsal margin and of valve 5: 12 (Type, Geol. Mus., Brisbane).
3. Length of dorsal margin and of valve 4: 9 (No. 53 Geol. Mus., Brisbane).

It may be noted here that in the case of three specimens of *E. mangaliensis* Jones (*Mon. Fossil Estheriae*, 1862, p. 78, pl. ii, figs. 16, 20 and 21), the ratios of the lengths of the dorsal margins and lengths of valves are 3:5, 1:3 and 7:18 respectively, exhibiting much variation. These proportions between the dorsal margins and the lengths of the respective valves do not support the identity of the Ipswich *Estheria* with the one from Mangali.

The anterior and posterior ends of the Ipswich *Estheria* are protrusively rounded, and in this respect differ from the Mangali species. The umbones are depressed only when distorted by pressure: ridges visible on mature Ipswich forms are twenty-two or more.



I consider this Ipswich *Estheria* to be a new species, and dedicate it to the locality or measures from which it was obtained.

It differs from *E. mangaliensis* (1) in having a more ovoid form, (2) a greater number of growth ridges, (3) in the individual specimens being more uniform in outline, (4) in having more protrusive anterior and posterior margins. From *E. forbesi* it is easily distinguished.

The illustrations of specimens of the species which accompany the present paper, so clearly show the important features of the species that the writer thinks it unnecessary to give further details except as to dimensions, which are as follows.

Plate iii, fig. 3, is from a specimen dealt with by Etheridge, who also examined the specimens shown on plate iii, fig. 4.

1. Length 5.0: width 3.0 mm. (Type, Geol. Mus., Brisbane).
2. Length 5.5: width 4.0 mm. (No. 27 Geol. Mus., Brisbane).
3. Length 6.0: width 5.0 mm. (No. 55 in Coll., Mitchell).

Loc.—Denmark Hill, Ipswich, Queensland.

Horizon.—Upper Triassic (Jack and Etheridge, Dunstan, Walkom and Tillyard).

ESTHERIA GLENLEENSIS, n. sp. Plate ii, fig. 6.

Spec. chars.: Carapace transversely oval, dorsal margin mildly sagged, the other margins rounded, the anterior strongly so; beak prominent about five-eighths anterior, concentric striae nine or ten in number distinct, widely spaced; the whole carapace convex.

Dimensions: Length 4.0; width 3.0, mm., approx.

This species is easily distinguishable from *E. coghiani*. In some respects it resembles *E. mangaliensis* Jones (*Mon. Foss. Estheriae*, 1862, pl. ii, fig. 16), but differs from that species in (1) having many less growth ridges, (2) having a more truncate posterior margin, (3) a more protrusively rounded anterior margin, (4) being of smaller size, and in having wider spaces between the growth ridges; also in having a less variable outline.

The horizons in which the Mangali and the Glenlee Estheriae are found do not differ much in point of geologic time, therefore their identity would not have been surprising, if such had been proven.

Loc.—The species was obtained from a cutting on the Great Southern Railway near Glenlee Homestead.

Horizon.—Wianamatta series.

The fossils found associated with this *Estheria* consist of other Estheriae, plants belonging to the genera *Taeniopteris*, *Macrotaeniopteris*, *Thinnfeldia*, *Cladophraxis* and *Phyllothea*, all of which go to show that the Wianamatta Estheriae dwelt in fresh water.

ESTHERIA WIANAMATTENSIS, n. sp. Plate ii, figs. 7, 8.

Spec. chars.: Carapace small convex, transversely subelliptic; beak sub-central; ridges six or seven only visible, interspaces relatively wide; anterior and posterior margins protrusively rounded dorsal margin arcuate, ventral margin mildly rounded.

Dimensions.—Length 3.0; width (depth) 2.0 mm.

This may represent an immature specimen, but even if that be so, its tumid, almost centrally placed beak and transversely elliptic shape, separate it from other Australian species, and also from *E. minuta* Alberti.

Loc. and horizon.—As for *E. glenleensis*.

ESTHERIA NOVOCASTRENSIS, n. sp. Plate iii, figs. 5, 6.

Spec. chars.: Carapace, outline subquadrate, dorsal margin straight, anterior and posterior margins truncate, ventral margin widely and gently rounded; concentric striae about twenty in number, fine, evenly spaced; test appears to have been of delicate texture, and is much crinkled; beak anteriorly situated and prominent.

Dimensions.—Length 8; width 6 mm. Another L = 9 and width 6 mm. (These dimensions are greater than for any other fossil *Estheria* from the Newcastle Series.)

I know of no species with which this can be either compared or contrasted with advantage, though in the number of striae *E. forbesi* Jones, and the present form approximate.

Loc.—Merewether Beach, a short distance S.W. of the outflow of the Newcastle sewerage; between low and high tide levels.

Horizon.—A few feet below the Dirty Seam of coal of Newcastle Coal Measures, associated with various species of *Glossopteris*, and with *Phyllothea australis*. Upper Permian.

ESTHERIA LENTICULARIS, n. sp. Plate iii, fig. 7.

Spec. chars.: Carapace lenticular, small, smooth; beak subanterior, inconspicuous; concentric striae very fine six or seven in number, interspaces increase in width as they approach the ventral margin.

Dimensions.—Length 2; width 1.8 mm.

The smoothness of the carapace and its small size are the two leading features of this *Estheria*; the fineness of its concentric striae is also very noticeable.

The only Australian *Estheria*, which may be compared and contrasted with it, is *E. wianamattensis*. They are both of small size and have few concentric striae on their valves, but the species here dealt with has a more prominent and anteriorly situated beak than the other one has. The fineness of the striae and smoothness of the carapace of the present species strongly contrast with the similar parts of *E. wianamattensis*. It is not improbable that the Wianamatta species descended from the more ancient one from the Newcastle coal measures.

Loc. and horizon the same as for *E. novocastrensis*.

ESTHERIA TRIGONELLARIS, n. sp. Plate iv, fig. 6.

Spec. chars.: Outline subtriangular, convex, dorsal margin slightly sinuate, short; the other margins well rounded; beak about two-thirds anterior, very prominent, elevated; concentric folds distinct, fairly regularly spaced, from the end of the dorsal margin, the upper part of the posterior margin is depressed along its edge. The description above is made from a mould of a left valve.

Dimensions.—Length 7.0; width 5.0 mm.

Loc. and horizon the same as for *E. novocastrensis*.

ESTHERIA OBLIQUA, n. sp. Plate iv, fig. 1.

Spec. chars.: Transversely suboblong, convex, posteriorly obliquely protrusive, dorsal margin long, straight anterior margin short, sharply rounded and gently

sinuate near the beak, posterior margin truncate; beak anterior and prominent; concentric folds, strongly developed, twelve visible; but probably had sixteen or more; they are strongly geniculated where they cross the umbonal fold, and as they near the ventral margin, they are reduced to striae and are closer together. The ornamentation apparently is made up of small globular bodies.

Dimensions.—Length 7·0; width 5·0 mm.

The specimen described has the valves in apposition, the right being under the left as may be observed by an examination of figure which represents the type.

Loc. and horizon the same as for *E. novocastrensis*.

ESTHERIA LATA, n. sp. Plate iii, figs. 8, 9.

Spec. chars.: Obliquely subflabellate, convex, smooth near the umbonal area; dorsal margin straight, half as long as the length of the valves; anterior margin distinctly rounded, posterior margin rounded and obliquely sub-protrusive, ventral margin widely rounded. Concentric striae. Fourteen visible, fine and fairly distinct, and regularly spaced; beak inconspicuous, subanterior.

Dimensions.—Length 7·0; width 6·0 mm.

This is a very distinct species, easily separated from all other Australian forms discovered up to the present time; also it ranks among the largest of the fossil Estheriae from Australian palaeozoic rocks. In some respects it resembles some forms of *E. forbesi* Jones (*Mon. Foss. Estheriae*, Palaeontological Soc., 1862, p. 109, Pl. iv, figs. 8-9) in a general way; but specifically it is a distinct type.

Loc. and horizon.—Merewether Beach, near the Newcastle Sewerage outlet; just below the Dirty Coal Seam, Newcastle Coal Measures, Upper Permian.

ESTHERIA BELMONTENSIS, n. sp. Plate iv, fig. 5.

Spec. chars.: The carapace subquadrate, flattish, dorsal margin straight, relatively long. Under the dorsal line there is a flat area which resembles a hinge plate, and which is not usually observed in members of the *Estheria* group; anterior subtruncate, and the posterior one widely and mildly rounded; ventral margin gently rounded, beak anterior, and inconspicuous, concentric striae, nineteen or twenty in number, distinct and fine.

Dimensions.—Length 6·0; width 5·0 mm.

This species in some features bears a strong resemblance to *E. ipsviciensis*, which may be a descendant of the older Permian type.

Loc.—The chert (Tuff) quarries near Belmont, Parish of Kahibah, County Northumberland, New South Wales, associated with several species of *Glossopteris*, *Leaia* and Insects.

Horizon.—Upper Permian.

ESTHERIA GLABRA, n. sp. Plate iv, figs. 2, 3.

Spec. chars.: Left valve testless, transversely subelliptic; convex; test was apparently thin and delicate; dorsal margin very gently curved, anterior and posterior margins rounded, ventral margin mildly rounded; beak, three-fifths anterior, prominent; concentric ridges, only three or four clearly visible, but traces of others can be seen with the aid of a good lens.

Dimensions.—Length 4·0; width 2·0 mm.

Although a large part of the cast of the valve above described has a smooth appearance, there is slight evidence that the concentric striae on the original test

were more numerous than are at present visible. Its much elongated subelliptic shape separates it from other Australian *Estheria*. The sparsity of its visible striae is another distinguishing feature. The type is a unique specimen.

Loc. and horizon the same as for *E. belmontensis*.

ESTHERIA LINGUIFORMIS, n. sp. Plate iv, fig. 4.

Spec. chars.: Carapace obliquely flabellate, and flattened along the borders of the postero-ventral margins. Dorsal margin straight and long, anterior margin short and rounded; posterior one wide and gently rounded; beak anterior, inconspicuous; concentric striae about eighteen in number, obliquely directed towards the postero-ventral margins, fine and compacted near the umbo and towards the postero-ventral margins, intermediate of these two areas they are distinct or ridged.

Dimensions.—Length 5.0; width 4.0 mm.

The above description of the type is made from a mould of a nearly perfect right valve.

This species, like *E. belmontensis*, bears some resemblance to *E. ipsviciensis*, so much so, indeed, as to make the assumption that the former is directly ancestral to the latter, not an unreasonable one.

The distinguishing features of this form are (1) its anterior beak, (2) long straight dorsal margin, (3) narrow anterior margin, and (4) wide posterior margin.

Loc. and horizon the same as for *E. belmontensis*.

ESTHERIA (?) BELLAMBIENSIS, n. sp. Plate iv, figs. 7, 8.

Spec. chars.: carapace sub-oblong, very inequilateral. Dorsal margin very long and straight, anterior and posterior margins gently rounded, or subtruncate; ventral margin subparallel to the dorsal one; beak, anterior, inconspicuous; concentric striae arranged in two sets—a wide apart set, and between each pair of these, finer ones occur, very numerous; the valves are convex.

Dimensions.—Length 10.0 mm.; width 6.0 mm. approximately.

If this fossil is an *Estheria*, it exceeds in size all other Australian species of the genus. In the character of its growth lines it resembles some *Unioneila*; but of three specimens known, each has a length of approximately 10.0 mm., and appears to be mature. This length is much less than any mature *Unioneila* possesses. The straight hinge line of the present fossil clearly separates it from molluscs of that group. In shape, size and surface ornamentation *E. bellambiensis* resembles the *E. striata* group. The length of the carapace of the species under discussion exceeds that of all other *Estheria*e known to me from palaeozoic rocks.

Locality.—The north side of the railway line connecting the South Bulli (Bellambi) Colliery with the staiths at Bellambi roadstead, associated with various species of *Glossopteris*.

Horizon.—About 150 feet below the seam of coal worked in the South Bulli Mine, and in stratigraphical position near to the Belmont Insect and Phyllopoda beds. Upper Permian.

My hearty thanks are extended to Dr. C. Anderson, Director of the Australian Museum, Sydney, for placing at my disposal for examination a number of recent *Estheria*e. To Mr. W. S. Dun, Palaeontologist, Department of Mines, Sydney; and to Mr. Booker, of the same Department, I tender sincere thanks for valuable aid extended to me while preparing the present paper. I am thankful to Mr. H. G.

Gooch, Photographer for the Department of Geology, University of Sydney, for some excellent photos of specimens dealt with in this paper, and lastly I am indebted to my friend T. H. Pincombe, B.A., of New Lambton, for the privileges of examining the Estheriae collected by Mrs. Pincombe and himself.

I wish to point out that in my paper on "Descriptions of New Species of *Leaia*" (These PROCEEDINGS, 1925, pp. 438-447) I have made a mistake in orienting the valves of the carapaces. I find that all right valves are designated left and the left valves right.

EXPLANATION OF PLATES II-IV.

Plate ii.

1. *Deltopecten rienitsi*, n. sp. right valve.
2. *Deltopecten rienitsi*, n. sp. left valve.
3. A right valve of *Estheria coghlani* Cox somewhat pressed into the left valve. From Cremorne bore. $\times 8$. Coll. Dept. of Mines, Sydney.
4. *Estheria coghlani* from Dent's Creek bore. $\times 10$. Coll. Mitchell.
5. *Estheria coghlani* from Glenlee (Wianamatta Series). $\times 14$. Coll. Mitchell.
6. *Estheria glenleensis*, n. sp. $\times 12$. Coll. Mitchell.
7. *Estheria wianamattensis*, n. sp. $\times 12$.
8. *Estheria wianamattensis*, n. sp. $\times 14$.

Plate iii.

1. *Estheria ipsviciensis*, n. sp. Left valve. $\times 8$. Coll. Mitchell. Presented by the Dept. of Mines, Brisbane.
2. *Estheria ipsviciensis*, n. sp. Left valve. $\times 10$. A good specimen. Coll. Dept. of Mines, Brisbane, No. 53.
3. *Estheria ipsviciensis*, n. sp. Left valve (depressed). $\times 10$. This valve was one dealt with by R. Etheridge Junr. as *E. mangaliensis*. Coll. Mines Dept., Brisbane.
4. *Estheria ipsviciensis*. The photograph shows two individuals on the same stone. They were examined by R. Etheridge Junr. (*loc. cit.*) $\times 10$. Coll. Dept. of Mines, Brisbane.
5. *Estheria novocastrensis*, n. sp. Left valve. $\times 5$. Coll. Mitchell.
6. *Estheria novocastrensis*, n. sp. Left valve. $\times 5$. Coll. Mitchell.
7. *Estheria lenticularis*, n. sp. $\times 12$. Coll. Mitchell.
8. *Estheria lata*, n. sp. $\times 6$. Coll. Mitchell.
9. *Estheria lata*, n. sp. Left valve. $\times 5$. Coll. Mitchell.

Plate iv.

1. *Estheria obliqua*, n. sp. Left valve. $\times 10$. Coll. Mitchell.
2. *Estheria glabra*, n. sp. Left valve. $\times 12$. Coll. Mitchell.
3. *Estheria glabra*, n. sp. A mould of right valve showing a more ovoid form than Fig. 2. $\times 9$.
4. *Estheria linguiformis*, n. sp. Right valve. Coll. Mitchell.
5. *Estheria belmontensis*, n. sp. $\times 7$. Coll. Mitchell.
6. *Estheria trigonellaris*, n. sp. Left valve. $\times 7$. Photo from a mould. Coll. Mitchell.
7. *Estheria* (?) *bellambiensis*, n. sp. $\times 6$.
8. *Estheria* (?) *bellambiensis*, n. sp. A pair of fragmentary valves joined along the hinge. $\times 6.5$. Coll. Mitchell.

(The photographs by H. G. Gooch, J. A. Booker and J. Mitchell.)